

system for the AVLIS process usually consists of two lasers: a copper vapor laser and a dye laser. The laser system for MLIS usually consists of a CO<sub>2</sub> or excimer laser and a multi-pass optical cell with revolving mirrors at both ends. Lasers or laser systems for both processes require a spectrum frequency stabilizer for operation over extended periods.

[61 FR 35605, July 8, 1996]

**APPENDIX G TO PART 110—ILLUSTRATIVE LIST OF PLASMA SEPARATION ENRICHMENT PLANT EQUIPMENT AND COMPONENTS UNDER NRC EXPORT LICENSING AUTHORITY**

NOTE—In the plasma separation process, a plasma of uranium ions passes through an electric field tuned to the 235U ion resonance frequency so that they preferentially absorb energy and increase the diameter of their corkscrew-like orbits. Ions with a large-diameter path are trapped to produce a product enriched in 235U. The plasma, made by ionizing uranium vapor, is contained in a vacuum chamber with a high-strength magnetic field produced by a superconducting magnet. The main technological systems of the process include the uranium plasma generation system, the separator module with superconducting magnet, and metal removal systems for the collection of “product” and “tails”.

(1) Microwave power sources and antennae.

Especially designed or prepared microwave power sources and antennae for producing or accelerating ions having the following characteristics: greater than 30 GHz frequency and greater than 50 kW mean power output for ion production.

(2) Ion excitation coils.

Especially designed or prepared radio frequency ion excitation coils for frequencies of more than 100 kHz and capable of handling more than 40 kW mean power.

(3) Uranium plasma generation systems.

Especially designed or prepared systems for the generation of uranium plasma, which may contain high power strip or scanning electron beam guns with a delivered power on the target of more than 2.5 kW/cm.

(4) Liquid uranium metal handling systems.

Especially designed or prepared liquid metal handling systems for molten uranium or uranium alloys, consisting of crucible and cooling equipment for the crucibles.

The crucibles and other system parts that come into contact with molten uranium or uranium alloys are made of or protected by corrosion and heat resistance materials, such as tantalum, yttria-coated graphite, graphite coated with other rare earth oxides or mixtures thereof.

(5) Uranium metal “product” and “tails” collector assemblies.

Especially designed or prepared “product” and “tails” collector assemblies for uranium metal in solid form. These collector assemblies are made of or protected by materials resistant to the heat and corrosion of uranium metal vapor, such as yttria-coated graphite or tantalum.

(6) Separator module housings.

Especially designed or prepared cylindrical vessels for use in plasma separation enrichment plants for containing the uranium plasma source, radio-frequency drive coil and the “product” and “tails” collectors.

These housings have a multiplicity of ports for electrical feed-throughs, diffusion pump connections and instrumentation diagnostics and monitoring. They have provisions for opening and closure to allow for refurbishment of internal components and are constructed of a suitable non-magnetic material such as stainless steel.

[61 FR 35606, July 8, 1996]

**APPENDIX H TO PART 110—ILLUSTRATIVE LIST OF ELECTROMAGNETIC ENRICHMENT PLANT EQUIPMENT AND COMPONENTS UNDER NRC EXPORT LICENSING AUTHORITY**

NOTE—In the electromagnetic process, uranium metal ions produced by ionization of a salt feed material (typically UCL<sub>4</sub>) are accelerated and passed through a magnetic field that has the effect of causing the ions of different isotopes to follow different paths. The major components of an electromagnetic isotope separator include: a magnetic field for ion-beam diversion/separation of the isotopes, an ion source with its acceleration system, and a collection system for the separated ions. Auxiliary systems for the process include the magnet power supply system, the ion source high-voltage power supply system, the vacuum system, and extensive chemical handling systems for recovery of product and cleaning/recycling of components.

(1) Electromagnetic isotope separators.

Especially designed or prepared for the separation of uranium isotopes, and equipment and components therefor, including:

(i) Ion Sources—especially designed or prepared single or multiple uranium ion sources consisting of a vapor source, ionizer, and beam accelerator, constructed of materials such as graphite, stainless steel, or copper, and capable of providing a total ion beam current of 50 mA or greater;

(ii) Ion collectors—collector plates consisting of two or more slits and pockets especially designed or prepared for collection of enriched and depleted uranium ion beams and constructed of materials such as graphite or stainless steel;

(iii) Vacuum housings—especially designed or prepared vacuum housings for uranium electromagnetic separators, constructed of suitable non-magnetic materials such as stainless steel and designed for operation at pressures of 0.1 Pa or lower.

The housings are specially designed to contain the ion sources, collector plates and water-cooled liners and have provision for diffusion pump connections and opening and closure for removal and reinstallation of these components; and

(iv) Magnet pole pieces—especially designed or prepared magnet pole pieces having a diameter greater than 2 m used to maintain a constant magnetic field within an electromagnetic isotope separator and to transfer the magnetic field between adjoining separators.

(2) High voltage power supplies.

Especially designed or prepared high-voltage power supplies for ion sources, having all of the following characteristics:

(i) Capable of continuous operation;

(ii) Output voltage of 20,000 V or greater;

(iii) Output current of 1 A or greater; and

(iv) Voltage regulation of better than 0.01% over an 8 hour time period.

(3) Magnet power supplies.

Especially designed or prepared high-power, direct current magnet power supplies having all of the following characteristics:

(i) Capable of continuously producing a current output of 500 A or greater at a voltage of 100 V or greater; and

(ii) A current or voltage regulation better than 0.01% over an 8 hour time period.

[61 FR 35606, July 8, 1996]

#### APPENDIX I TO PART 110—ILLUSTRATIVE LIST OF REPROCESSING PLANT COMPONENTS UNDER NRC EXPORT LICENSING AUTHORITY

NOTE—Reprocessing irradiated nuclear fuel separates plutonium and uranium from intensely radioactive fission products and other transuranic elements. Different technical processes can accomplish this separation. However, over the years Purex has become the most commonly used and accepted process. Purex involves the dissolution of irradiated nuclear fuel in nitric acid, followed by separation of the uranium, plutonium, and fission products by solvent extraction using a mixture of tributyl phosphate in an organic diluent.

Purex facilities have process functions similar to each other, including: irradiated fuel element chopping, fuel dissolution, solvent extraction, and process liquor storage. There may also be equipment for thermal denitration of uranium nitrate, conversion of plutonium nitrate to oxide metal, and treatment of fission product waste liquor to a form suitable for long term storage or dis-

posal. However, the specific type and configuration of the equipment performing these functions may differ between Purex facilities for several reasons, including the type and quantity of irradiated nuclear fuel to be reprocessed and the intended disposition of the recovered materials, and the safety and maintenance philosophy incorporated into the design of the facility. A plant of the reprocessing of irradiated fuel elements, includes the equipment and components which normally come in direct contact with and directly control the irradiated fuel and the major nuclear material and fission product processing streams.

(1) Fuel element chopping machines, *i.e.*, remotely operated equipment specially designed or prepared to cut, chop, or shear irradiated nuclear reactor fuel assemblies, bundles, or rods.

(2) Critically safe tanks, *i.e.*, small diameter, annular or slab tanks specially designed or prepared for the dissolution of irradiated nuclear reactor fuel.

(3) Solvent extraction equipment.

Especially designed or prepared solvent extractors such as packed or pulse columns, mixer settlers or centrifugal contactors for use in a plant for the reprocessing of irradiated fuel. Because solvent extractors must be resistant to the corrosive effect of nitric acid, they are normally fabricated to extremely high standards (including special welding and inspection and quality assurance and quality control techniques) out of low carbon stainless steels, titanium, zirconium or other high quality materials.

(4) Chemical holding or storage vessels.

Especially designed or prepared holding or storage vessels for use in a plant for the reprocessing of irradiated fuel. Because holding or storage vessels must be resistant to the corrosive effect of nitric acid, they are normally fabricated of materials such as low carbon stainless steels, titanium or zirconium, or other high quality materials. Holding or storage vessels may be designed for remote operation and maintenance and may have the following features for control of nuclear criticality:

(i) Walls or internal structures with a boron equivalent of at least 2 percent, or

(ii) A maximum diameter of 7 inches (17.78 cm) for cylindrical vessels, or

(iii) A maximum width of 3 inches (7.62 cm) for either a slab or annular vessel.

(5) Plutonium nitrate to plutonium oxide conversion systems. Complete systems especially designed or prepared for the conversion of plutonium nitrate to plutonium oxide, in particular adapted so as to avoid criticality and radiation effects and to minimize toxicity hazards.

(6) Plutonium metal production systems. Complete systems especially designed or prepared for the production of plutonium metal,